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THE HWANG HO, YELLOW RIVER

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From Kansu to Shantung the Hwang Ho is a dirty yellow. This color whence the river takes its name comes from the silt-like loess which it carries in suspension and which likewise gives name to the sea into which it flows. The river-borne loess is at once source of prosperity and of disaster. The alluvial plains of the Hwang Ho are of extraordinary fertility; but in its lower course the aggrading stream periodically breaks its banks, devastating the surrounding country and earning its well-known synonyms, "China's Sorrow," "The Ungovernable," and "Scourge of the Sons of Han." [1]

HISTORICAL IMPORTANCE OF THE HWANG HO

In the basin of the great river, with its vast agricultural possibilities and its difficult problems of water control, Chinese civilization acquired its distinctive character. All accounts agree that this basin was the "cradle of the Chinese race." Whatever the origin of the race—and it seems most probable that they were a steppe people from the west—we find the Chinese at the dawn of history settled on the hill-sheltered plains of Shensi, whence they spread to the wide plains of the east, of Chihli and Shantung.[2] In the fertile plains are the ancient centers of religion and culture—from Sianfu (Singanfu), historic capital of the Wei Ho valley, to Tsinanfu at the foot of the holy mountain of Shantung. Among legends concerning the Hwang Ho is one that out of the river the original Chinese dragon brought to Fu-hi (whose reign is said to have commenced at Sianfu in B. C. 2852) the scroll on which were engraved "the eight permutations," or strokes from which the Chinese alphabet has developed.

[1] L. Richard: Comprehensive Geography of the Chinese Empire, Shanghai, 1908, p. 28.

[2] For references to current theories on the subject see the next article, "The Geographical Factor in the Development of Chinese Civilization," by C. W. Bishop, p. 19. Special reference should be made to E. T. Williams: The Origins of the Chinese, *Amer. Journ. of Phys. Anthropol.*, Vol. 1, 1918, pp. 183–211.

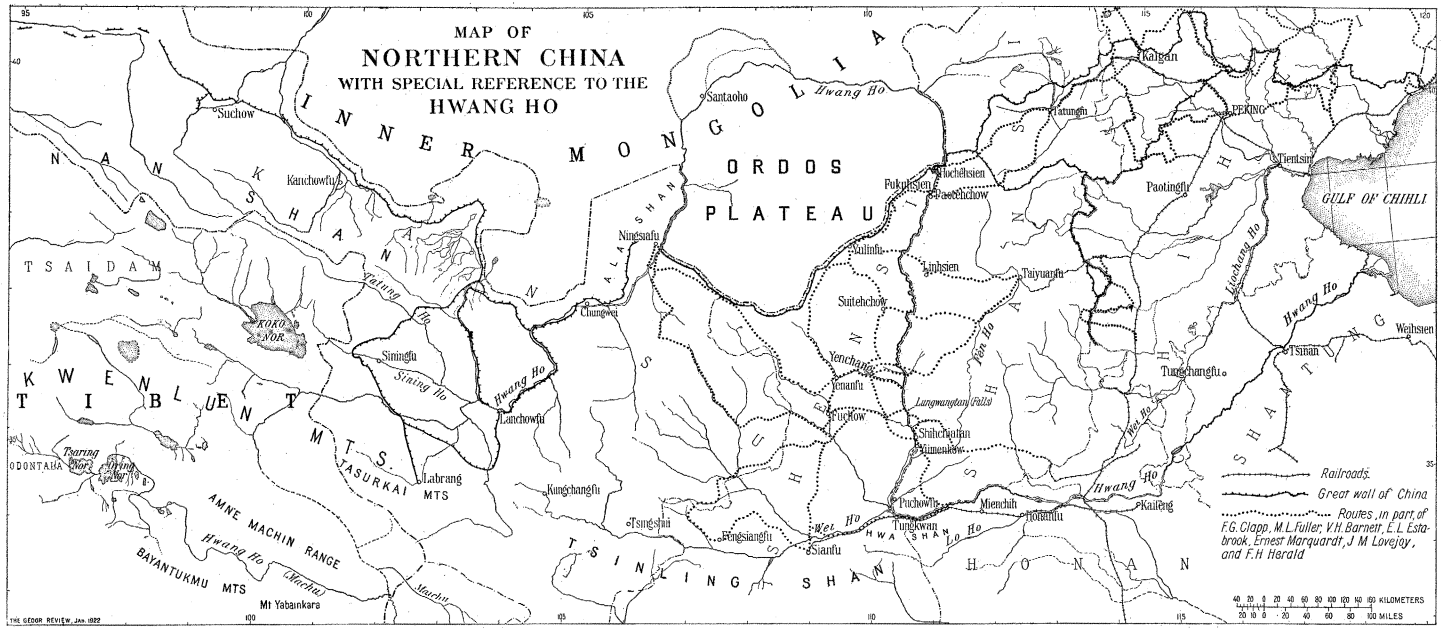

FIG. 1—Sketch map of the Hwang Ho. Approximate scale 1 : 11,000,000. The map is reduced from that of the Great Wall of China (scale 1 : 2,000,000), *Geographical Review*, Vol. 9, 1920, with additions to complete the course of the river, and with revisions of the routes followed by the author and his associates.

Source and Upper Reaches of the Hwang Ho

The great river [3] rises in east-central Tibet about 60 miles west of Tsaka Nor (lake) or Tsaring Nor, south of the Kwenlun Mountains and of the Koko Nor region. The region was visited by Przhevalski in 1884, who says that the Yellow River "is formed at a height of 13,600 feet by two streamlets, flowing from the south and west, out of the mountains scattered about the plateau, and is fed by numerous springs of the wide marshy valley (40 miles by 13⅓ miles) known by the name of Odon-tala, known to the Chinese as *Sing-su-hai*, or starry sea."[4] Rockhill crossed the Odontala a few miles west of Tsaring Nor in 1889 entering from the Ts'aidam basin by the Bordzakera pass, 15,650 feet elevation. In the valleys were many large bears, practically the only inhabitants. Rockhill tells us that every year in the seventh moon the source of the Hwang Ho was worshipped by the Chinese Emperor, who sent an official to sacrifice a white horse and seven or eight white sheep. The officials, however, are supposed usually to have pocketed their expense money and to have refrained from purchasing and making the animal sacrifice.[5] Tafel visited the region in 1906. He describes the main source of the river as lying in a depression at the western end of the Odontala about 100 kilometers west of Tsaring Nor, in latitude 35° N. and longitude 95° E., and at an elevation of 4,350 meters (14,270 feet). He credits Tsaring Nor with an elevation of 4,260 meters (13,975 feet) above sea level.[6] From the Tsaring Nor the Yellow River flows into the Khnora Nor, or Oring Nor, a few miles east. The eastern shore of this lake and a part of the upper course of the Yellow River were traversed and mapped by the Filchner expedition of 1903–1905.[7] Other tributaries of lakes Oring and Tsaring are said to bring more water into them than the stream commonly recognized as the source of the river.

The upper part of the Hwang Ho is called Soloma by the Mongols and Ma ch'u or Rma ch'u by the Tibetans, and it is also known as Alten Gol or Gold River. The old highway from Siningfu in western Kansu to Lhasa, the capital of Tibet, crosses the Hwang Ho only a few miles west of Tsaring Nor. From the lakes the river flows eastward for 200 miles and then bends northwestward, flowing in places in a broad valley where the stream itself is over 600 feet across.

In the year 1908 Vicomte d'Ollone, a major in the French army, traveled from Sungpan, in northwestern Szechwan, down the "Little Yellow River"

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[3] Certain parts of the course have never been traversed; hence the length of the river can only be estimated. Richard gives 2,700 miles, the figure given by the U. S. Geological Survey (*Press Bull. 478*, October, 1921); common school geographies give a length of 2,800 miles; the writer places it at 2,900; and Herrmann (Der Hwang-ho, *Zeitschr. der Gesell. für Erdkunde zu Berlin*, 1916, p. 86) apparently at 3,075 miles, that is only slightly less than the Yangtze.

[4] Letters from Colonel Prejevalsky, *Proc. Royal Geogr. Soc.*, Vol. 7, 1885, pp. 167–172; reference on p. 170.

[5] W. W. Rockhill: The Land of the Lamas, New York, 1891, pp. 170–173.

[6] Albert Tafel: Meine Tibetreise, 2 vols., Berlin, 1914; reference in Vol. 2, p. 20 and map.

[7] Wilhelm Filchner: Wissenschaftliche Ergebnisse der Expedition Filchner nach China und Tibet, 1903–1905, 11 vols., Berlin, 1906–14. A short account of the work of the expedition, with map, is given in *Deutsche Rundschau für Geographie*, Vol. 37, 1914–15, pp. 521–526.

to where it meets the Yellow River near the apex of its great bend in eastern Tibet. That portion of the river was said not to have been previously explored. Although Ollone expressed his opinion that the source of the Hwang Ho is in the Amne Machin range of mountains, from 100 to 300 miles farther east than the ordinarily supposed source, no evidence seems to exist of the truth of this suggestion. Ollone's opinion was based on the fact the nomadic tribes living in the vicinity of the Amne Machin range call it the Anyei Machi.[8] He explains that "in their language *anyei* signifies 'ancestor', and *Machi* is their name for the Yellow River," hence, that the name of the mountain range would signify "ancestor of the Yellow River." According to Ollone "it is the universal belief that this range contains the principal springs of the river, which have hitherto been attributed to the lakes Nyoring-So and Doring-So."

The Yultao Hwang Ho, or Little Yellow River, reaches the Great Yellow River, which is rather more rapid, in the midst of a level plain; and the slower stream is repulsed so that the channel is almost checked by the detritus. Caravans composed of hundreds of yaks and fighting men with long gleaming lances come from the Tibetan desert regions every few months, crossing near the mouth of the Little Yellow River and proceeding thence to Sungpan (Songpanting) in northwestern Szechwan. They are composed largely of merchants of that place, who carry tea into the Koko Nor region and return with hides and pelts.

According to Ollone, who carried a theodolite, the tip of the great bend is about 60 miles farther east than it appears on maps published previous to 1912.[9] The Little Yellow River rises a few miles northwest of Sungpan and runs northwestward over 200 miles through a barren mountain region to its confluence with the Hwang Ho. The Tibetans call this principal tributary the Maichu and call the main river the Machu or Machi. It should be noted that Ollone does not place the mouth of the Little Yellow River on the tip of the great bend, but about halfway from there to the point where the Yellow River again bends northeast. The region of the Yultao Hwang Ho is thinly populated by the federation of Dzorgei, comprising wild tribes living by pillage as well as by cattle raising.

Occupying the great bend of the Hwang Ho and westward is the mountain mass now known as the Kwenlun, of which the Amne Machin range is the eastern end. South of this stretch of the river lie the Bayantukmu Mountains and Mt. Yabainkara.

Near the confluence of the two Yellow Rivers, hidden in a hollow of the mountains, stands the convent of Chaga Weisyong; and near the headwaters of the Tana Chu in the northern flanks of the Tasurkai Mountains is the celebrated lamasery of Labrang. The latter has hitherto been mentioned as the terminus of the southern branch of the Kansu loop of the Great Wall

[8] Vicomte d'Ollone: In Forbidden China, transl. by Bernard Miall, London, 1912, p. 256.

[9] *Op. cit.*, p. 250. In *La Géographie*, Vol. 21, 1910, p. 438, Ollone gives the position of the most easterly point of the great bend as latitude 33° 34′ N. and longitude 102° 10′ E. (99° 50′ E. of Paris).

of China, but Ollone found the Great Wall continued as a lofty rampart, still guarded by an outpost of soldiers, about 100 miles farther south, only one day's journey north of Sungpan,[10] in the borders of Szechwan.

The Hwang Ho in Kansu Province

The elevation of the Hwang Ho on the Tibet-Kansu boundary is given as 8,230 feet above the sea, and at Lanchowfu 5,100 feet.[11] About 70 miles east of the Kansu border it is crossed by the west limb of the so-called "Tibetan Loop" of the Great Wall of China.[12] It passes the city of Sünhwa a few miles farther on, and about the center of eastern Kansu it reaches Lanchowfu, at which point the "Tibetan Loop" joins the main Kansu loop of the Great Wall.

In this part of its course the Hwang receives from the west an important tributary, the Sining Ho, which, with its own tributary the Tatung Ho, rises in the Koko Nor region and enters the Hwang Ho about 40 miles above Lanchowfu. In the same region the Tao Ho enters from the south, flowing from the northern slopes of the Min Shan on the border of Tibet east of the great Tibetan loop of the Hwang.

The great city of Lanchow, the capital of Kansu Province, picturesquely surrounded by heights crowned with pagodas and built on both banks of the Yellow River, was crossed until recently by a bridge of boats over 600 feet in length, known in China as the "most beautiful bridge in the world." In 1909 it was replaced by a fine steel bridge whose construction was supervised by an American engineer, Robert Coltman 3rd. This is the only bridge over the river till that on the Peking-Hankow railroad is reached in the eastern maritime provinces. The bridge is crossed by a continuous stream of travelers, proceeding to and from the east and west along one of the greatest highways of the world (the old "silk road"). This great route connects Sianfu with the provinces of Sinkiang, western Mongolia, northern Tibet, western Siberia, and Turkestan. Along it the two-wheeled cart is the principal means of long-distance travel, but wheelbarrows are also common. Lanchowfu is the principal stopping place in Kansu for most of this traffic. The population, variously estimated at figures ranging from half a million to less than 100,000,[13] is largely Mohammedan, but one sees nearly all eastern religions represented. Ollone compares the mingling of peoples on the bridge thoroughfare with that on the bridge of the Golden Horn. The streets of Lanchowfu are narrow for the cities of northern China; but the houses are mostly well built, and the city walls and gate towers are in good repair. The chief industries are related to tobacco and fur brought

[10] Ollone, *cit.*, p. 217.

[11] Albert Herrmann: Der Hwang-ho. Versuch einer Monographie nach Filchners und Tafels Forschungen, *Zeitschr. der Gesell. für Erdkunde zu Berlin*, 1916, pp. 79–94; reference on p. 86.

[12] See the author's article "Along and Across the Great Wall of China," *Geogr. Rev.*, Vol. 9, 1920, pp. 221–249.

[13] R. S. Clark and A. de C. Sowerby (Through Shên-kan, London, 1912, p. 60) give 500,000; Tafel (*op. cit.*, Vol. 1, p. 151) compares the several estimates that have been made. He is of the opinion that the town numbers not more than 120,000 at the outside.

from the west; but gold, silver, and jade merchants and curio dealers were numerous in the days of the Empire.

The valley of this part of the river is fertile and intensively cultivated by irrigation. Water for the purpose is raised by means of wooden wheels with attached buckets placed in the current along the banks (compare Fig. 13, p. 35). The surrounding country, however, is dry and barren. The river at Lanchowfu is frozen over for one and a half months in the year.

Fifteen miles below Lanchowfu is the little village of Hsiaoshuitzu[14] perched on a rocky cliff on the south bank of Hwang. At that place the

FIG. 2—Gorge of the Hwang Ho—narrows in Sinian limestone—near Hochêhsien in northwestern Shansi. (Photograph by E. L. Estabrook.)

tortuous but swift river cuts deeply into granitic rocks and turns abruptly to pursue a general northeasterly direction.

Until Chungweihsien is reached the river flows through gorges, and its course is marked by rapids.[15] It is, however, navigated to some extent by rafts and boats, the former being the safer. Below Chungwei the Ordos is entered. In its stretch northeastward from Kansu through the Ordos the Hwang Ho flows mainly through desert, which has buried former cultivated plains and in places even the Great Wall. At Chungwei a new loop of the river has temporarily restored the fertility of the soil and supports a fairly large population. Some irrigation is done in such places, but long-buried cities exist in this region. The northern boundary of a portion of eastern Kansu follows the Hsi, Holan, or Ala Shan (mountains), which are bordered on the south for over 100 miles by the Hwang Ho. In this part of its course

[14] Clark and Sowerby, *op. cit.*, p. 59.

[15] Eric Teichman: Routes in Kan-su, *Geogr. Journ.*, Vol. 48, 1916, pp. 473–479.

the river is deflected northward by the Ordos plateau. Throughout the greater portion of its course in Tibet and Kansu the Hwang appears to traverse mainly crystalline rocks, though at Ningsiafu on the border of the Ordos the stream is not far distant from the western border of the Carboniferous basin of eastern Kansu and Shensi. The river leaves Kansu Province at an elevation of about 3,300 feet above the sea.

On the line of the Great Wall, close to the Mongolia-Kansu-Shensi border is the important city of Ningsiafu in an oasis of considerable size. At Santaoho, somewhat more than 150 miles below here, Belgian Catholic

FIG. 3—One of the many picturesque glimpses of the Hwang Ho in the stretch between Shansi and Shensi. (Photograph by E. L. Estabrook.)

missionaries have introduced irrigation, planted trees, excavated irrigation canals, and redeemed a tract from the desert, so that a substantial Christian mission which was built up years ago includes some thirty villages. The "burgomaster" of that community is as much its ruler as is the Magistrate of most Chinese municipalities.

THE HWANG HO IN MONGOLIA

About 150 miles north of Ningsiafu the river bends gradually eastward under the influence of the highlands comprising the Charanarin Ula or Lan Shan on the north. In this vicinity the Hwang has at various times had several ancient courses, which in one case differ from its present channel throughout a distance of over 180 miles, the middle point of which lies nearly 50 miles outside its present position.

The region comprised in this great bend of the Hwang Ho north of Shensi Province is known as the Ordos Desert, roughly circular and about 250

miles across. A part of the Desert of Gobi, it is one of the most barren regions of the world, although it once had a civilization whose existence is evidenced by buried cities and other instances of culture. Its sand dunes, quicksands, and barren hills are inexpressibly dreary and have been crossed by few travelers.

About 400 miles below Ningsiafu the river again bends southward, at the point where it strikes the Shansi boundary. Steamers sometimes descend the river as far as Hokow just within the boundary. Below Hokow navigation becomes difficult. In the autumn of 1914 S. H. McClure, working under

FIG. 4—A loess "bridge" near Yenchang, Shansi. Such features, which sometimes are true bridges, are common in the high plateau of Shensi. Usually they are only practicable for travel on foot or in the saddle.

the direction of the writer, made a hazardous trip by flatboat from Hokow 100 miles downstream to Hochêhsien, descending the dangerous rapids known as the "Dragon's Mouth." The river in places passes through miles of deep gorge and towering cliffs between which the waters rush and swirl.

The river crosses the Great Wall at Hochêhsien, a branch of the wall partly in ruins bordering the left bank of the river from 10 miles or more above this point to 15 or 20 miles below it. Ten miles above Hochêhsien the Hwang is intersected by a fault against the edge of Carboniferous coal-measure rocks, and the Sinian [16] (Cambro-Ordovician) rocks are thrown down to the north, forcing the river to bend abruptly west as far as Hochê-

[16] The term Sinian, introduced by Pumpelly to express a system of folds in eastern Asia, was applied by Richthofen to a limestone formation in northeastern China where these folds prevail. See J. S. Lee: An Outline of Chinese Geology, *Geol. Mag.*, Vol. 58, 1921, pp. 259–265, 324–329, 370–377, and 409–420; reference on p. 328.

hsien where it again turns south. The river appears to be about 3,000 feet above sea level, and the high rolling hills reach to about 4,300 feet. From here southward the Hwang Ho crosses sediments of Carboniferous age, though for the major part of its Shensi-Shansi course the river is not far from the contact of the Carboniferous with the hard Sinian limestone which rises in the high mountain ranges to the east.

It may be noted here that in northern Shensi, some miles west of Fukuhsien, deposits of volcanic tuff and agglomerate indicate the existence of a former vulcanism in that general section of the country. The enormous

FIG. 5—Chingshuikwan, Shensi, from the Shansi shore. Chingshuikwan lies at the foot of a typically rough loess trail one day's journey northeast of Yenchang.

"volcanic bombs" found in the agglomerate stratum suggest the former existence of a great volcano.

THE SHENSI-SHANSI PORTION OF THE RIVER

Thirty or thirty-five miles below Hochêhsien are Paotehchow, an important walled and turreted city on the Shansi bank of the river, and Fukuhsien, a similar city on the Shensi side. The party accompanying the writer and Edward L. Estabrook first visited Paotehchow, subsequently ferrying across to the other side. Both cities impress one as being much more prosperous than places visited farther east in spite of the difficulties of the trails. These are very great.

In their geology, topography, and industries the adjoining portions of Shansi and Shensi closely recall portions of Pennsylvania and West Virginia.

The hilly character of the trails, for instance, is a reminder of similar roads in West Virginia. From an altitude of 4,500 feet above the sea at the summit of Chienhungai Liang, eight miles east of Paotehchow, one descends to less than 3,000 feet at the river level, crossing a region of deep valleys on the sides of which are exposed coal-bearing Carboniferous rocks, standing out in sharp contrast from the overlying loess. The mines are operated by natives after their own primitive methods, and long lines of mules laden with great "run-of-the-mine" lumps may be seen starting to transport the coal eastwards. Here and there in the valleys stand numbers of brick and tile kilns and pottery works. The section closely resembles the deep ravines in the vicinity of Pittsburgh; one almost expects to see modern coke ovens or the chimneys of Homestead pouring forth their smoke. Nevertheless the air is clear.

The loess country of Shansi and Shensi is one of the roughest and strangest in the world.[17] In all the approaches of the writer's parties to the river or its side valleys, hundreds of feet were climbed in loess. When wet the loess is as slippery as the most argillaceous clay, so that the steep grades of the trails are then impassable. Most of the loess trails leading out of the valleys have grades of over 25 degrees. During wet weather it is impossible to reach the plateau.

With its coal mines and ferries and the pottery business Paotehchow is destined to become an ever more important place than it now is. The people are not antagonistic to strangers but have the ever-present curiosity of the Chinese concerning anything new or foreign. The existence of a small but comfortable inn enabled the writer's party to decline a cordial invitation from the Magistrate to stop in his *yamên*, and in front of the inn the populace celebrated the visit of Americans by setting off firecrackers both night and morning. The quarters proved to be the most comfortable between Peking and Yülinfu. An excellent Chinese dinner given by the civil and military officials and principal Chinese merchants proved a pleasant event.

At a point lower down on the river, at Hwanghoyeh, the Clark-Sowerby expedition crossed going west in the autumn of 1908.[18] The altitude was estimated as 2,400 feet above the sea, and 3,000 feet below the pass 20 miles distant on the highway to Linhsien in Shansi. The average height of the range between the Hwang Ho on the west and the Fên Ho on the east is 7,000 to 8,000 feet; but some crystalline peaks, like Mo-êrh Shan, rise much higher.

Below Paotehchow the next place at which the river was seen by a party under the direction of the writer was about 80 miles lower down, at Machia-tun on the Shansi bank, 35 miles northwest of Linhsien. A crossing here was made by the late V. H. Barnett.

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[17] The writer has given a short account of the loess in his article "Along and Across the Great Wall of China," *Geogr. Rev.*, Vol. 9, 1920, p. 228.

[18] Clark and Sowerby, *op. cit.*, p. 14.

FIG. 6

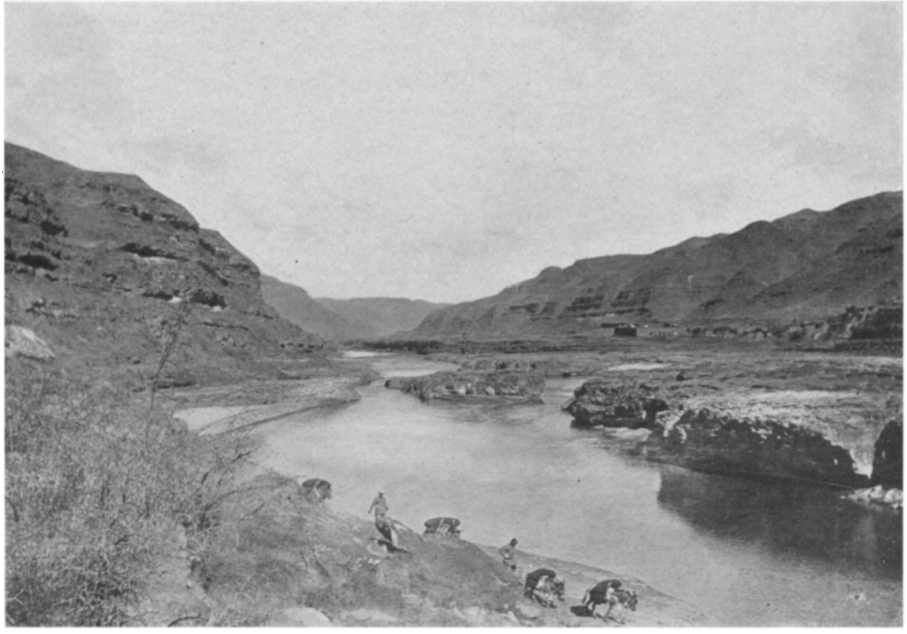

FIG. 7

FIG. 6—The Hwang Ho looking downstream from Chingshuikwan.

FIG. 7—The Hwang Ho looking upstream from a point between Kochent'an and the falls of Lungwangchan. Old fortifications are seen on the Shansi shore.

Farther down the Hwang Ho was approached at Chingshuikwan. To reach it we crossed shaky loess or sandstone cliffs which had been undermined by water, traveled on roadways hardly two feet wide with canyons 100 feet deep on both sides and frequently having yawning pits close beside them several feet in diameter and apparently bottomless.

The similarity of this part of the Hwang Ho canyon with that of the Colorado is not mere fancy, for here the great valley abounds with mesas as does that of the Colorado, and strata of sandstone and shale are piled a thousand feet one upon another up to the loess which rises hundreds of feet higher to the plateau level, making a picture long to be remembered.

The Hwang Ho is only an eighth of a mile wide at Chingshuikwan, so that one can almost speak across it; but, when the writer's party wished to cross the ferrymen steadfastly refused for three days to enter the boats, declaring the current too rough for safety. We could now appreciate the reply of the Magistrate of Yenchanghsien in Shensi who, a few days previously, on being asked what could be done to help the city, had responded, "Build a bridge over the Hwang Ho." The single available ferryboat was small and leaky, accommodating only thirteen men and three animals by crowding; and with this load the party finally succeeded in reaching the Shansi shore.

The climb from the river level was up 1,700 feet over rock and loess hills bounded by deep canyons, across which distant views of mountain and valley were at times secured. Finally, 3,600 feet above the stream, the party stopped for the night in a cave village underlying a wheat and vegetable field on the loess plateau. Within a few score of miles this portion of the Hwang Ho has been crossed by several of the writer's parties, including those of John M. Lovejoy and Edward L. Estabrook. Crossings here were also made by Myron L. Fuller, associated with the writer in the explorations in China.

The vicinity of Shihchiat'an, still farther down the river, is quite different in aspect from the country around Chingshuikwan. Instead of living in caves the people have substantial houses, and the narrow stretches of flood plain contain frequent small farms. A short distance below Shihchiat'an are coal mines which give rise to various industries. The river is navigable from near there to a point in the province of Honan, and numerous boats can be seen floating down or being "tracked" upstream.

A highway along the Shansi side of the river near Shihchiat'an was built at the time of the Taiping Rebellion and was then probably a good road; but it is now in such bad repair as to be barely passable for horses. Along six miles or more of it, paralleling the Hwang Ho, the ruins of a massive stone wall built at that time can still be seen. It is six to eight feet high and two feet or more in thickness, with numerous portholes, and must have proved an effectual barrier to attacks from the river or from the Shensi shore.

Land and Water Transportation

The entire portion of the Hwang Ho between Shensi and Shansi is inaccessible by cart or by any form of vehicular travel, and the mountain trails are perhaps the roughest in the world. A cart road from the north touches the river at Potow in Mongolia and another at Hokow, about 100 miles apart on the northeastern portion of the Ordos loop. The former road extends northeast through Mongolia, the latter eastward in Shansi Province to Fengchen and Tatungfu. Both highways make connection with river shipment.

Traveling on the middle stretch of the river is said to average three to four miles an hour. At Laolungkow, in the stretch between Hokow and Paotehchow, is a very dangerous rapid caused by a single large rock in the river. Although from 500 to 1,000 boats descend this rapid every year, the loss is said to be less than one per cent, or about three or four boats a year. The river is open to navigation at Hokow about the first of April, is generally closed during July and August on account of heavy rains, and is again passable in September, October, and November.

In a few places where the water is low the cargo must be unloaded and reloaded. The boats seldom if ever return north but are sold at their southern destination. Some of the larger boats are said to carry as much as 30,000 pounds on a trip. The boats are commonly guided through the dangerous spots by experienced local pilots, and the Chinese boatmen are accustomed to burn incense when passing through the "Dragon's Mouth."

The Great Falls

A few miles above Shihchiat'an on the Shensi shore is Kochent'an in the district of Yichuan. This part of the Yellow River, visited by the writer in March, 1914, is one of its wildest sections. The gorge consists of a deep canyon, and in order to reach the river level the party was obliged to descend 1,500 feet from the loess plateau. In one place, on a tributary of the Hwang Ho, is a rock cliff over 100 feet in height over which a cascade plunges in the rainy season, and for miles the river is walled by much higher cliffs.

The "ferry" on which the river is crossed is situated directly below a constricted portion, where the waters are concentrated and plunge madly over some dangerous rapids. Although stories had been heard of the "rapids" at Lungwangchan, four miles above this ferry, no one present was prepared for the magnificent cataract found there. Strange to say, it is scarcely mentioned in Chinese books available to the interpreters. It was, however, visited by Tafel in 1905 and has been described by him.[19] At a distance of many miles the clouds of spray resembled white smoke rising from a spot in the river valley. To this finally the military escort pointed and cried "Lungwangchan." At a distance of a quarter of a mile, moisture begins to blow in one's face, rendering photography difficult.

[19] Tafel, *op. cit.*, Vol. 1, pp. 61–62 and Pls. 17, 18, and 19.

The river is swift at Kochent'an and more so throughout the four miles upstream between that village and Lungwangchan, where the entire river, narrowing from a breadth of perhaps 1,000 feet, plunges into a deep gorge scarcely over 100 feet across, with a roar that rivals Niagara. The vertical drop is little over 50 feet at any one place in the river bed, but the stream descends 200 feet within five miles. As the entire volume of the Hwang Ho pours over the falls, it makes up for any lack of height.

On witnessing the falls one is at first inclined to discredit the story that boats descend the Hwang Ho from Mongolia to Honan. While standing on the brink of the canyon a mile or more below the falls, however, the writer heard a wild yelling in unison from across the valley, and over the sandstone terrace came a line of forty to fifty men, moving slowly southward as if with difficulty. Behind them, at the end of a stout cable, was being dragged a boat with its load of freight. Later other groups of men were seen dragging similar boats. Thus the inhabitants of Lungwangchan derive their living.

Between Lungwangchan and Yumenkow farther down stream are two other rapids, in which boats are sometimes lost. One is at Taoerwo, 20 miles south of the same place. Below Yumenkow the river is easily navigable to Sanmen, 17 miles northwest of Mienchih in Honan, where a great rock partially obstructs the river. The currents are said to flow towards this rock from three directions, and on it appear Chinese characters signifying "Come to me," or "Sail in my direction." By this scheme the navigator is induced to head his boat in the direction of the rock, and then the current carries him safely round it. If, however, the boatman expends his energy in trying to sail round the rock, it is said he will certainly strike it and be destroyed. Opposite Mienchih is a port named Mengchienhsien connecting it by a good cart road.

The principal tributaries of the Hwang Ho in its Shansi-Shensi stretch are the Fên Ho from the east and the Wei Ho from the west, the former being estimated as 500 miles in length and the latter at least 400 miles. The Wei Ho heads only a few miles from the source of the Tao Ho, a large tributary of the Hwang Ho south of Lanchowfu. Several other tributaries on the Shensi side are over 100 miles long.

A few legends have come to us of the early history of Shensi, which are of interest concerning the Hwang. For instance in B. C. 2297 the "prosperity of the nation," one book states,[20] was disturbed by a "thirteen-years flood." Some think that this was the Biblical flood, but accounts indicate that it was of local character. It seems to have covered the entire valley of the Hwang Ho and part of that of the Wei. Emperor Yau ordered various officials to subdue the waters, for failing to do which they were executed. However, a man of the name of Yu, who afterwards became "Yu the Great," tried for eight years to accomplish the task and finally succeeded in carrying off the water by deepening the channels. He is said to have evolved his scheme

[20] Li Ung Bing: Outlines of Chinese History, Shanghai, 1914, p. 6.

of drainage by studying the marks on a turtle's back. So the Chinese have a saying, which has come down to the present day, that "we should have been fish but for Yu."

Incidents on Route

Northern Shensi is scantily settled, and in the Ordos Desert few houses were seen, while Messrs. Fuller and Barnett who visited northwestern Shensi found they could travel all day without seeing a house. Generally, however, small villages exist every few miles, with such names as "Sanchia" (three families), "Shihlipu" (ten li shop), "Pachiats'un" (eight family

Fig. 8—Lungwangchan, the "Great Falls of the Hwang Ho," in the lower portion of the Shensi-Shansi course of the river. The falls are impressive because of the volume of water carried and the great constriction of the river bed.

village), and other equally attractive designations. Most of these places are merely cave villages—unimpressive and sometimes most forbidding to the weary traveler who is looking for a good stopping place. Yet they are dry and comfortable inside, and an entire caravan manages to be accommodated even at places like "Sanchia," "Fanti," or "Tuenchiao."

The police of Chinese cities are of many contrasts as to appearance and efficiency. Some are dressed in clean, new uniforms, carry effective rifles, and would be recognized at once as members of an efficient police force, while others wear ragged clothing and have guns which appear to be half a century old. The Magistrates, or chief governing officials, vie with each other in efforts to provide proper protection to a traveler, every Magistrate furnishing at least as large an escort as the preceding one on the route

traveled and so properly passing on the expedition to the next *hsien* or district city. On the journey from Fukuhsien west to Yülinfu, the prevalent custom of furnishing large escorts resulted in great enthusiasm along the route, so that before reaching Yülinfu the travelers were being greeted daily by music and receptions, all of which is evidence of recent lack of travel from eastern China in this distant region.

On the highway running east and west through Sianfu restaurants and native "quick lunch" rooms are abundant. A sample dinner en route may be mentioned. Among the delicacies served were *chi-tz'erh*, *chao* (eggs, scrambled), *wan-tze* (meat balls), *yo pien* (chopped pork), *chi pien* (chopped chicken), *shon lui pai tsai* (Chinese cabbage with vinegar), *lao bing* (griddle cakes), *fan* (rice), and *cha* (tea). The total cost to geologist and interpreter was 786 cash, or about 25 cents in American money, and enough food was left over to furnish the waiter with a meal for himself.

The River at Tungkwanting

At the great bend of the Hwang, a few miles below the mouth of the Wei Ho, is situated the city of Tungkwan. The valley begins to narrow here, and the city walls occupy the entire space between river and hills, thereby exercising full military control over the main highway from Honan Province along which all traffic must pass to approach Sianfu, the capital of Shensi. Tungkwan lies in Shensi but so close to the borders of Shansi and Honan that it may be said to constitute the key to three provinces. Its great stone citadel has only one approach, and it is high on the hills and well protected, while the business section lies below.

For thousands of years the battlements of Tungkwan have guarded the road to Shensi, and it is one of the few places that Jenghis Khan could never storm. In his first campaign for the conquest of China that great general sent an army to take Kaifêngfu. Reaching the river opposite Tungkwan, the army decided to avoid the place and started on a detour through the mountains of southern Shensi, in which it encountered such great hardships that it was defeated and driven back across the Hwang Ho into Shansi province to the north.

At Tungkwan is a ferry which is well traveled by the natives, being one of the great ferries of China. It is one in which sails are sometimes used instead of oars, although poles are also of value in crossing during low-water stages.

At three days' journey east of Tungkwan was seen what is reported to be the "oldest tree in China," not living but encased in a brick wall. There appears good evidence that it is as old as the beginning of the Chou Dynasty, about 3,000 years ago. The tree appears to be a cypress and is a dead trunk 40 feet in height. The base is encased in a mortared brick wall, surrounded by tablets, several of which are so ancient as to be illegible. One bears the inscription "Ancient Kan-tang," another says "Kindness of Chou Kung."

The story is that a man of that name came from the West some 3,000 years ago and stopped under this tree to preach the "doctrines of civilization." He was so kind that the inhabitants ever afterwards kept the tree intact in his memory, and the duty of its protection was passed down from generation to generation.

Origin of the Shensi-Ordos Loop

Certain fundamental factors lead us to suppose the Hwang Ho has not always flowed as it does now. Leaving out of account historical floods as being too recent to have permitted the later development of any great valley, there are certain evidences that the portion of the Hwang Ho between Shansi and Shensi dates only from Quaternary time. Coming from the sizable valley with moderate gradient which extends from Lanchowfu and Hokow, the river restricts itself for 550 miles as far as Tungkwan between valley walls less than a mile apart rising semi-vertically in rock and overlying steep loess slopes to 1,000 or 1,500 feet above the river, quite different from the topography in other parts of the river's course. Although near Hochê-hsien the river passes through Sinian limestone for some miles, the rest of its southward course is excavated canyon-like in rock of Carboniferous age. This valley does not appear older than many Pleistocene or late Pliocene valleys in America and Europe. Moreover, there are, at Lungwangchan and several other points, rapids and falls entirely incommensurate in age with the Mongolian section of the river. It seems clear that the Shensi-Shansi portion of the river is younger geologically.[21] The fault at the base of the Hwa Shan range south of Tungkwan appears to be a continuation of the great Wei Ho fault. The Wei Ho valley, trending west of Tungkwan in direct continuation of the Honan course of the Hwang Ho, has a breadth of over 50 miles, a flat floor, a navigable river, and a great population. This valley heads only some 50 miles south of Lanchowfu—a fact which suggests that it may once have served as a basin for the Hwang Ho itself. In order to obtain a correct idea of the geography of this great river system, however, and of the causes of changes in its course, one would be obliged to examine the divides back from the source of the Wei.

Another region that deserves study from a similar angle is that east of Potow on the Ordos loop. If ancient valleys should be found there they would shed light on the problem. We can hardly doubt that the present Hwang River is a composite one; but further study is necessary to give definite answers to all of the questions that may be raised.

Lowland Portion of the Hwang

The lowland portion of the river may be considered to be that part east of the pass of Tungkwan, where it deviates from its previous southward

[21] On interpretation of youthful character of the Hwang Ho in its Shensi-Shansi course see "Research in China," 3 vols. and atlas, *Carnegie Instn. Publ. No. 54;* reference in Vol. 1, Part I, pp. 234–236. See also J. S. Lee, article cited in footnote 16, pp. 419–420.

course and flows nearly east to a point about 25 miles below Kaifêngfu, where it bends northeast towards the Gulf of Chihli.

Near Hwaikingfu the river passes out of its gorges and reaches the great plain of Honan and Chihli, on which it is locally navigable. In the vicinity of Takouchên the writer traveled over many miles of rich agricultural country, mainly planted with winter wheat, dotted with long lines of prosperous villages. There are also miles of great bamboo thickets, in which the trees tower high above the traveler and in the vicinity of which the chief industry is the manufacture of bamboo goods. Adjoining this great plain the rough limestone mountains of Shansi rise abruptly 2,500 feet in height, and the main road over them is paved for miles with great blocks of limestone. Fine views of the Hwang Ho can be gained from the summits.

Where the Peking-Hankow Railroad crosses the Hwang Ho the river consists of a channel or series of channels aggregating one or two miles in breadth. The water is shallow, and the channels are continually shifting. This part of the river, according to unpublished notes of Myron L. Fuller, is navigable to small boats drawing a foot or a foot and a half of water and carrying perhaps three tons of freight. The clearance at the railroad bridge runs from 10 feet at low water to less than half that at high water.

Changes in the River's Lower Course

Crossing great flood plains in its lower stretches the Hwang Ho has frequently changed its course in past ages. It has flowed alternately north and south of the mountains in Shantung Province, reaching the sea at points as much as 250 miles apart in an air line.[22] Its last important change was in 1851 previous to which time it left the present channel at the sharp bend east of Kaifêngfu, flowed southeastward through northern Honan and Kiangsu, and reached the sea only 130 miles from the mouth of the Yangtze Kiang. The Grand Canal followed the course of the Hwang Ho from Sutsien to Hwaianfu, a distance of about 60 miles. In the year 1851 the dikes gave way east of Kaifêngfu, and for two years the course varied considerably; but finally the Hwang embedded itself in the Tsi Ho, which had previously been of little importance. Another flood, which occurred in 1877, inundated an immense region and caused the death of millions of people and in 1898 was still another great flood. (See insert map, Fig. 1, p. 21.)

It is in the lower portion of the river that floods are now frequent and most dreaded. The flood phenomena consist in the bringing down of great quantities of mud from higher regions and the continual raising of the river bed which now stands many feet above the surrounding country. For instance where the Hwang crosses the Grand Canal in Shantung Province the river is said to be 16 feet above the canal level. On account of frequent floods no important city is built on the river banks in its lower course.

[22] See the maps, Pls. 4 and 5, in Raphael Fumpelly: Geological Researches in China, Mongolia, and Japan, *Smithsonian Contributions to Knowledge, No. 202*, Vol. 15, Art. 4, Washington, D. C., 1866; and Jakob Menauer: Die Laufänderungen des Gelben Flusses in historischer Zeit, Nuremberg, 1912.